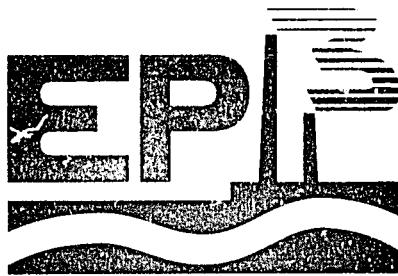


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**Environmental Pollution  
Prevention Project**

A Report of the  
Office of Environment and Natural Resources  
Bureau for Global Programs  
United States Agency for International Development

**POLLUTION PREVENTION DIAGNOSTIC STUDY  
TINTORERIA PEDRO de VALDIVIA, S.A.  
SANTIAGO, CHILE**

Final Report

Prepared for:

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January 1994

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## **ACKNOWLEDGEMENTS**

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The pollution prevention audit/assessment reported on herein was conducted by a team of EP3 and industry representatives. The primary purpose was to assist industry or facility management in creating a sustainable pollution prevention and waste minimization program. This report presents information from the first step in the process; a base line survey and a definition of actions which can be taken to prevent pollution, improve efficiency and pay back any required investments.

The overall EP3 program in the countries in which EP3 has activities includes a wide range of activities including audits/assessments, information dissemination, training and small scale demonstrations. These country programs are all designed to create the conditions in the country which will assure the continuation of urban and industrial pollution prevention and establish locally sustainable pollution prevention programs.

This report was prepared for RCG/Hagler Bailly, Inc. by William W. Bilkovich,  
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## CHAPTER 1: EXECUTIVE SUMMARY

1

The principal opportunities for Tintoreria Pedro de Valdivia, S.A. to reduce the plant's impact on the environment and reduce costs are summarized in Table 1. Changes that result in reduced energy use will avoid the release of 0.5 metric tons of air emissions each year in addition to unquantified reductions in the release of global warming gases and heavy metals. Water use can be reduced by 66,000 cubic meters per year. Chemical releases to the surface waters of Chile can also be reduced. The reductions in chemical releases require more research and development before they can be quantified.

Of the eleven opportunities recommended, the savings possible from implementing two have been quantified. These two recommendations, recycling bleach rinse water and capturing the heat in boiler blowdown water, will reduce operating costs by about \$3,700,000 per year for an initial investment of \$700,000. The simple payback period for these changes is ten weeks. Another \$1.35 million in investments is required to implement other changes whose savings potential is at least \$5.85 million.

All savings and costs in this report are quoted in Chilean pesos worth 414 pesos per U.S. dollar.

**TABLE 1**  
**Summary of Pollution Prevention Opportunities**

SYSTEM	OPPORTUNITY	POLLUTION PREVENTION POTENTIAL	CAPITAL COST TO IMPLEMENT	ACTION REQUIRED: SECTION
Bleach Rinsing	Reduce water use, recover process chemicals and heat by recycling bleach rinse water	Reduce water use by 23,000 m <sup>3</sup> /year. Reduce water costs by \$2,600,000/yr	\$500,000 to replumb existing tanks	Switch jet-cooling piping to steel tanks, train operators. Section 4.1.1
Dye Rinsing	Reduce water use by recycling second dye rinse	Reduce water use by 43,300 m <sup>3</sup> /yr. Reduce water costs by \$5,300,000/yr	\$1,000,000 for two tanks and associated plumbing	Observe bleach rinse recycling system, test color of dye rinse effluent. Section 4.1.2
Boiler	Recover heat from boiler blowdown	Reduce fuel use by \$1,100,000/yr, reduce temperature of effluent	\$200,000	Purchase valves and plumb boiler blowdown. Section 4.2.2
Dye Process	Reduce liquor ratio in jet dyeing	Reduce water use by up to 4,800 m <sup>3</sup> /yr, reduce water cost by \$550,000/yr	None	Experiment with 9.5:1 liquor ratio. Section 4.3.1

## CHAPTER 1: EXECUTIVE SUMMARY

**TABLE 1**  
**Summary of Pollution Prevention Opportunities**

SYSTEM	OPPORTUNITY	POLLUTION PREVENTION POTENTIAL	CAPITAL COST TO IMPLEMENT	ACTION REQUIRED SECTION
Dye Process	Reduce liquor ratio in jet dyeing	Reduce water use by up to 4,800 m <sup>3</sup> yr, reduce water cost by \$550,000 yr	None	Experiment with 9:5:1 liquor ratio, Section 4.3.1
Chinese Reactive Dyes	Control dye process using Fong equipment	Reduce redye and chemical costs, unquantified	None	Standardize incoming dye lots with Fong equipment Section 4.3.2
Dye Process	Use Fong equipment to determine acetic and formic acid concentrations for specific dyes	Reduce use of chemicals, reduce BOD 5 of effluent, unquantified	None	Choose specific dye, monitor actual performance of acids, Section 4.3.2
Reactive Dyes	Determine actual price break point for one and two-step dyeing	Reduce dye use, decrease cost of dyeing, unquantified	None	Measure all inputs required for one and two-step processes for a specific dye, Section 4.3.3
Dispersed Red 60 Dye	Change dyes to improve heat fastness	Reduce dye in effluent, reduce dyeing costs, unquantified	None	Consult with dye supplier, Section 4.3.4
Effluent	Reduce suspended solids in effluent by installing screens	Keep effluent in compliance	\$50,000	Install parallel bar screens, Section 4.4.1
Effluent	Reduce sulfide in effluent by aeration and exposure to light	Reduce sulfide in effluent, prevent sewer deterioration	\$50,000	Install grate on sewer, Section 4.4.2
Effluent	Determine effluent concentrations for controlled parameters, determine reduction priorities	Keep effluent in compliance, identify priority pollutants for reduction	\$250,000 for testing	Initiate sampling program, examine test results, Section 4.4.3
TOTALS		\$3.7 to \$9.6 million plus unquantified opportunities	\$1,050,000 to \$2,050,000	

The purpose of this study was to perform an environmental assessment of a textile dyeing plant and to propose a program of pollution prevention. The study was done under the Agency for International Development, Environmental Pollution Prevention Project (EP3) under the direction of AMCHAM - CHILE by RCG Hagler Bailly Inc. Mr. Charles Sweeney (CDS Laboratories, Loganton, PA) and Mr. William Bilkovich (Environmental Quality Consultants, Tallahassee, FL) were the Industrial Pollution Prevention consultants to RCG Hagler Bailly Inc. The services of independent Chilean consultant Jorge Castillo G. were used to assist in the technical and operational aspects of the project.

## **CHAPTER 3: INTRODUCTION**

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Tintoreria Pedro de Valdivia (Valdivia) is a commission dye house serving Chilean fabric manufacturers. The plant operates two twelve-hour shifts, six days per week. In 1992 Valdivia wet-processed 960,000 kg of fabric. Most of these fabrics were cotton-synthetic blends.

EP3 program personnel visited Valdivia as part of a search for candidates who expressed an interest in pollution prevention. After obtaining a commitment from Valdivia to make every effort to implement pollution prevention opportunities, a pollution prevention diagnostic study was commissioned. An initial interview was conducted to discuss what such a study would cover and what data would need to be collected. Attending this meeting were: Mauricio Roldan of AMCHAM Chile; Eduardo Maal, RCG/Hagler, Bailly; and Patricio Majluf Sapag, General Manager of Tintoreria Pedro de Valdivia, S.A.

After the initial briefing, Charles Sweeney, Industrial Pollution Prevention consultant to RCG and Mauricio Roldan spent one morning investigating plant processes. A few days later Charles Sweeney, William Bilkovich, Industrial Pollution Prevention consultant and Jorge Castillo G., a Chilean consultant completed the diagnostic study. At the end of the plant visits, William Bilkovich prepared a preliminary report. With the report as a guide, an exit interview was conducted two days after the second plant visit. The recommendations in the report and a preliminary plan of action were discussed.

Section 4.0 consists of a detailed discussion of those recommendations. Section 5.0 details the time required to implement the recommendations and presents a budget for that implementation. Section 6.0 summarizes the effect that implementation will have on the environment.

**4.1 Reducing Water Use**

Fabric processing in jets involves many rinse steps that use large quantities of water. Water use at Tintoreria is now near the limits of system capacity. The resulting low water pressure increases the cycle time for fabric processing by extending the time needed to fill jets with water. Any reduction in water use would therefore increase plant productivity as well as reduce water purchase costs. If many kilos of the same colored fabric are dyed in succession, countercurrent rinsing can be built into the structure of jet dyeing equipment. Triple countercurrent rinsing can reduce water use (compared to single rinsing) by a factor of 50 and still maintain the same quality of final product. Commission dyeing houses change colors frequently and run small lot sizes. This increases the number of tanks, valves and piping external to the jet machines which must be installed to handle each of the process chemicals and colors before countercurrent rinsing can be implemented. Tintoreria has the tanks and lines in place to isolate and reuse one of its rinses. An examination of fabric processing was undertaken to determine the changes needed to implement rinse water reuse.

Table 2 outlines the steps required to process poly-cotton fabric. For each process step, the amount of water used is given. Based upon conversations with plant personnel, it was determined that overflow rinse water is allowed to flow for between 10 and 15 minutes. Water use for these two rinse flow rates is presented in the second and third columns. A number of assumptions have been made to complete this table. Based upon information that it takes 4 minutes to add 1,300 liters to a 150 kg jet, the overflow rinse rate is assumed to be 325 liters per minute. The plant has four 150 kg high temperature jets, one 150 kg atmospheric jet, two 100 kg atmospheric jet and one 400 kg high temperature jet. Assuming that these jets are utilized equally, the weighted average load of fabric is 169 kg. Most fabric is dyed at a 10:1 liquor ratio. The average fill volume of a jet is therefore 1,690 liters. Assuming that 80,000 kg of fabric is wet-processed each month, an average of 5,680 loads of 169 kg each would be processed each year. Finally, assuming that the plant uses a combination of EMOS and well water amounting to 20,000 cubic meters per month, the average water use is 250 liters per kg of wet-processed fabric.

**TABLE 2**  
**Process Water Use at Tintoreria Pedro de Valdivia**

Process	Water Use for 10 Minute Rinses	Water Use for 15 Minute Rinses
Fill for Bleaching	1,690 l	1,690 l
Heat at 98° C for 30 min		
Overflow Rinse Until Cool	3,250 l	4,875 l
Dump and Refill	1,690 l	1,690 l

## CHAPTER 4: RECOMMENDATIONS

**TABLE 2**  
**Process Water Use at Tintoreria Pedro de Valdivia**

Process	Water Use for 10 Minute Rinses	Water Use for 15 Minute Rinses
Heat to 80° C		
Overflow Rinse Until Clear	3,250 l	4,875 l
Dump and Refill	1,690 l	1,690 l
Add Dye Chemicals		
Heat at 130° C for 45 Min		
Cool by Heat Exchange to 80° C		
Add Reducing Solution		
Hold at 80° C, 15 Min		
Overflow Rinse Until Cold	3,250 l	4,875 l
Dump and Refill	1,690 l	1,690 l
Heat to 50° C, 10 Min		
Overflow Until Cold	3,250 l	4,875 l
Dump and Refill	1,690 l	1,690 l
Heat to 40° C, add Dye		
Add Soda Ash, Hold 30 min		
Add Caustic, Hold 1 hr		
Overflow Rinse Until Cool	3,250 l	4,875 l
Dump and Refill	1,690 l	1,690 l
Heat to 50° C, Hold 5 Min		
Overflow Rinse Until Clear	3,250 l	4,875 l
Dump and Refill	1,690 l	1,690 l
Heat to 98° C, Add detergent, Hold 10-15 Min		
Overflow Rinse Until Clear and Cool	3,250 l	4,875 l
Dump and Refill	1,690 l	1,690 l
Heat to 40° C		
Add Acetic Acid		

**TABLE 2**  
**Process Water Use at Tintoreria Pedro de Valdivia**

Process	Water Use for 10 Minute Rinses	Water Use for 15 Minute Rinses
Hold 20 Min		
Drain		
Centrifuge		
Dry		
Comb, Sometimes Iron		
Fill Water Used per Load	13,520 l	13,520 l
Rinse Water Used per Load	22,750 l	34,125 l
Total Water Used per Load	36,270 l	47,645 l
Liters kilogram Assuming 169 kg loads	215 l/kg	282 l/kg

To estimate the actual average overflow rinsing time, assume that the overall water use is 250 l/kg. The average 169 kg load would then require 42,250 liters for all purposes. If 13,520 liters are used for the eight fills of the jet, 28,730 liters remain for the seven rinses in the process. Each rinse therefore uses 4,100 liters. At 325 liter/minute, each overflow rinse would take 12.6 minutes, a figure which agrees closely with plant estimates of overflowing rinse times. For purposes of calculating savings from rinse water recycling it is assumed that 4,100 liter of water is used per rinse.

#### 4.1.1 Bleach Rinsing

Three processes use two overflowing rinses in succession without the addition of any chemicals between the two rinses: 1) bleaching with caustic soda and hydrogen peroxide; 2) reducing with caustic soda and sodium hydrosulfite; and 3) rinsing between the second dyeing and detergent washing. In the first of these processes, bleaching, the chemicals do not change between successive batches of fabric. Recycling the second bleach rinse back in the process for use in the first rinse could begin immediately to reduce water use. This second rinse water has a lower concentration of contaminants than the fabric being rinsed in the first rinse. Using recycled second stage rinse water for first stage rinses is standard practice on large through-put modern machinery. The second rinse would first be used as the water to make up the initial bleaching bath. The remaining second rinse water would then be used to begin the first rinse. The total avoided water use per batch is limited, however, to the volume of the

## **CHAPTER 4: RECOMMENDATIONS**

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second rinse recycled. In the second and third processes, the presence of residual dye, which could be of a different color for each bath, requires more research before recycling those rinse waters is attempted.

If the hot water from the jet heat-exchangers were stored in the two unused steel tanks which were installed for a heat exchange system which was not implemented, the two 8,000 liter fiberglass tanks now used for jet cooling-water storage would be made available for bleach rinse water recycling. Bleach rinse water is too caustic to store in the steel tanks, but the jet cooling water could be stored with little chance of subsequent fabric contamination (once the steel tanks were cleaned). As will be discussed below, other heat exchange possibilities are created by this change in tank use. The 16,000 liter capacity of the two fiberglass tanks may be large enough to allow most bleach rinse water to be recycled.

If there are 5,680 loads of fabric run each year, then there is a load processed every 90 minutes. The time elapsed between the beginning of the process and the end of the second 4,100 liter overflowing bleach rinse is also about 90 minutes. With perfect staggering, each 8,000 liter tank has twice the needed capacity, making the system capable of holding four rinses. This is about as much tank capacity as would be needed if half of the jets were on exactly the same schedule.

It is suggested that bleach rinse water be run from the jets to one of the fiberglass tanks. That tank should be plumbed to overflow into the second tank. Rinse water for reuse should be drawn from near the bottom of the second tank. The top of the second tank should be fitted with an overflow to the sewer. That overflow should have an open section where the pipe from the tank discharges into a funnel atop the last section of the overflow. This will prevent solutions siphoning back from the drain and allow operators to know when the rinse recycle system is full. Both tanks should have drains to allow removal of accumulated solid precipitates which may form over time. The storage of bleach rinses will recover heat now lost to the drain and possibly reduce the temperature of the plant's effluent.

The potential savings from reduced water use from such a recycling system can be calculated. The energy savings from the recovery of rinse water heat were not determined and are not included in the savings. Assuming that 4,100 liters of the 8,200 liters used for the two bleach rinses is reused and that 5,680 loads per year are processed, the quantity of water that will be saved is 23,288 cubic meters per year (1,940 cubic meters per month). Water is supplied to the plant from two sources, EMOS and an on-site well. The on-site well is operated at full capacity 24 hours per day delivering 7,000 cubic meters per month. Any additional water needed, up to 14,000 cubic meters per month in 1993, is drawn from EMOS. Any reduction in water use, up to 168,000 cubic meters per year (14,000 cubic meters per month), would therefore be avoided EMOS water. EMOS water costs \$114 per cubic meter including all taxes and sewer charges. The avoided cost of saving 23,288 cubic meters per year (1,940

cubic meters per month) is \$2,654,832. The \$500,000 estimated cost of capturing these savings is the cost of re-plumbing the jets to be able to deliver and receive water from the two fiberglass tanks.

#### 4.1.2 Dye Rinsing

If research into the color intensity of the second rinse in the two dye-rinsing operations indicates that there is not enough color to cause a problem in rinsing other colored batches, then those rinse processes could also be modified to use recycled second rinse water. The additional savings would be 43,300 cubic meters per year ( $3,600 \text{ m}^3/\text{month}$ ) worth \$5.3 million for a total savings of 69,864 cubic meters per year (5,820 cubic meters per month) worth \$7,964,496. If both rinses can be recycled, water use can be reduced by about 25%. Recycling the two dye rinses would require the purchase of additional tanks for each rinse stream and the installation of the associated plumbing. The cost of two 8,000 liter tanks and the associated plumbing is estimated to be \$1,000,000. As experience is gained in bleach water recycling, the timing of operations in different jets will provide information which can be used to determine the minimum tank size needed for dye rinse recycling.

The plant is now near its capacity to deliver softened water to the jets. The limiting factor in reducing cycle times is the time it takes to fill a jet with water. When more than one jet is filling at once, the time needed for filling can increase by a factor of three. If bleach rinse water is recycled, the pumps and the water available from that system will take some of the load off the water system thereby reducing cycle times. The savings from increased plant throughput may be significant, but have not been calculated and are not included in the savings given above.

### 4.2 Modifications to Recover Waste Heat

#### 4.2.1 Changing Jet Cooling Water Recovery Tanks

After polyester dyeing, the solution in the jet is cooled with a heat exchanger from  $130^\circ \text{ C}$  to  $80^\circ \text{ C}$ . Dye solution is circulated through one side of the exchanger and fresh softened water is passed through the other. Currently, that soft water is then routed to two 8,000 liter fiberglass tanks. When warm soft water is needed for other dyeing steps, it is drawn from those tanks. This system recovers some of the heat that is rejected from the jets and uses the cooling water twice. To recycle bleach rinse water without fear of contamination from the action of the caustic bleach rinse on steel tanks, those two fiberglass tanks should be used for bleach water. The jet cooling water should be piped to the two steel tanks with heat exchange coils that are currently not being used. Because the jet cooling effluent is warm, soft water, corrosion of the steel tanks should be minimal. Changing from the fiberglass to

the steel tanks does not increase heat recovery. It only changes the location of that heat recovery in order to allow the recycling of bleach rinse water.

#### 4.2.2 Recovering Boiler Blowdown Water Heat

The two steel tanks recommended for use with jet cooling water are fitted with heat exchange coils. GAMA recommended retrofitting the boilers with a continuous blowdown system. If the water from that system were routed through these coils, heat could be recovered into the used jet cooling water. It is suggested that both water for fabric processing and boiler feed water be drawn from this tank. This would make maximum use of the heat from both jet-cooling and boiler blowdown water. Each boiler should be connected to a single tank's coils to avoid cross-connecting the two boilers through the heat exchange system.

The amount of energy available in the blowdown water has already been quantified by GAMA. They estimate the savings could be \$1.1 million (106 UF) per year, assuming a 50% efficient heat transfer mechanism. The heat transfer equipment GAMA suggested to capture the energy in the boiler blowdown water has a payback of about 9 years and is therefore not recommended. Routing the blowdown through the jet cooling water tanks would be much cheaper to accomplish, requiring only piping and valves. The heat rejected to the jet cooling water should be sufficient to keep the water in the two tanks quite hot, recapturing the energy for both boiler make-up water use and for fabric processing. With this system, the heat in the contaminated blow-down water could be recaptured without the installation of new tanks or heat exchangers and without contaminating process water with boiler feedwater chemicals.

#### 4.2.3 Effect of Heat Recovery on Effluent Temperature

The temperature of the effluent must not exceed 35° C at any time. Some of the rinse waters discharged exceed 75° C. Reusing these rinses will reduce the heat rejected to the effluent. Heat will be reused in the process and radiated from the rinse storage tanks. Recapturing heat from the continuous blowdown waste stream will also help reduce effluent temperature. A cascade can be installed if the effluent is still too hot after all possible rinse streams have been recycled and blowdown and jet-cooling heat have been captured. A pump would be used to draw effluent from the sump and spray it onto the top of a series of wooden boards. The cooled effluent would then return to the sewer system. This would cool the effluent and help dissipate any accumulated sulfide. If suspended solids are a problem, the pump could send effluent through a cyclone to remove solids before it is delivered to the cascade.

Another method of reducing effluent temperature would be to place a stainless steel heat exchanger in the effluent stream. If a portion of incoming cold water were run through this exchanger, waste heat could be recovered from the effluent and the temperature requirements

of the regulatory authorities could be met. The results of the bleach, dye rinse and blowdown changes recommended above will determine whether additional heat recovery methods will need to be employed.

### **4.3 Process Control Modifications**

#### **4.3.1 Reducing Liquor Ratios During Dyeing**

Jet dyeing machinery of the type used at Tintoreria can be run at lower liquor ratios than 10:1. It may be possible to run the equipment as low as 5:1. The limiting factors are fabric tensile qualities and pump cavitation. Reducing the liquor ratio to 5:1 on 5,680 loads per year would save 4,800 cubic meters per year worth \$550,000. Additional un-quantified savings might be gained through better dye exhaustion. The high value of the fabric being processed requires that such experimentation be done in small steps. The loss of one batch of fabric through mechanical damage would negate the value of a year's worth of water savings.

#### **4.3.2 Use of Fong Dyeing Equipment**

The Fong dye-process simulator should be put into use as soon as possible. It should be used to study preparation and dyeing processes instead of relying exclusively on the formulae provided by chemical suppliers. Savings will come from individualizing these formulas to the plant's unique needs. At a minimum this equipment should be used to inspect incoming reactive dyes for consistency of color. Adjustments made at the beginning of the dyeing process based upon dye lot variability are more cost-effective than additions of chemicals later in the process when problems are discovered on the fabric. This is of major importance with highly variable Chinese reactive dyes.

The laboratory can also use this equipment to help optimize the use of chemicals such as acetic and formic acids. These process chemicals are the two largest contributors to biological oxygen demand in the effluent.

#### **4.3.3 Compare One and Two-step Dyeing Costs**

Less expensive Chinese reactive dyes are applied using a two-step method that requires more time, water and energy than the one-step process which can be used with more expensive European dyes. A detailed study should be made of these two methods comparing the actual cost of all inputs, including the value of jet-dyer and operator time, instead of just the purchase cost of the dye. This will be especially useful when European reactive dye prices start to fall. The actual break point price should be determined.

**4.3.4 Thermo-migration of Dispersed Red 60**

The plant is experiencing a problem with thermo-migration of Dispersed Red 60. Dye suppliers should be consulted for a higher migration temperature red dye for application where fastness to high temperature migration is required.

**4.4 Reducing Effluent Contaminant Concentrations****4.4.1 Reducing Suspended Solids in Plant Effluent**

Total suspended solids and sedimentable solids are two of the parameters that future sewer effluent regulations will control. The principle source of these contaminants is lint from fabric. Effective screening of lint is usually adequate to keep plant effluent below the limits. Parallel bar screens should be installed in the jet room where drains meet and at the entrance to the main sewer, sump. Screens made of parallel bars are much easier to clean than are rectangular screens. Each sector of a rectangular screen must be cleaned by hand. Parallel screens can be rapidly cleaned with a small rake.

**4.4.2 Reducing Sulfide and Heat in the Effluent**

Sulfide is created in sewer systems by the anaerobic digestion of organic material, especially wool lint which contains keratin, a sulfur-containing protein. This process is promoted by the lack of oxygen in sums and is accelerated by the heat contained in the effluent. Replacing the cover on the sump with a grate that allows light and air to enter would promote oxygenation, allow hydrogen sulfide to dissipate and increase heat exchange, cooling the effluent. The more-efficient removal of lint, recommended in the previous section, will reduce the amount of organic material in the sump, thereby depriving bacteria of food.

**4.4.3 Gather Information on Influent and Effluent**

Santiago is about to promulgate standards for effluent discharged to the public sewers. This sewer system flows directly into the two rivers which pass through the city. No information has been gathered about the composition of the water used nor the effluent discharged by the plant. Analytical data on influent and effluent water should be collected. Influent analysis for both EMOS and well water should include pH, conductivity, hardness, calcium, sulfates, chlorides, turbidity and total dissolved solids. Effluent analysis should include pH, sulfates, total dissolved solids, temperature, suspended solids, oils and greases, sulfides, color, BOD 5, COD, Ammonia, Total Nitrogen, Total Phenolics, Copper, Chromium, Lead, Zinc, and Mercury, detergents, and hydrocarbons. The effluent should be a weekly composite of at least 6 daily grab samples. When the samples are taken, record pH, flow, and temperature. Flow should be recorded by measuring the depth of flow in the sump at the time the sample is taken. The relative flow rates at the time each sample was taken can then be determined in

case the flow rate is highly variable. When taking samples, avoid skimming the surface where oils and greases accumulate. Such skimming will improperly load the sample with these contaminants.

The concentration of some of the pollutants of concern can be calculated based upon purchases of production materials. Based upon information supplied by Tintoreria, a BOD 5 level of 40 ppm from acetic and formic acids can be expected. Total BOD 5, after accounting for contributions from the fabric, should be approximately 100 ppm, well below the standard of 300 ppm. Total nitrogen, based upon purchases of ammonium sulfate and ammonium hydroxide should be about 5-10 ppm. The standard is 80 ppm. Sulfate added by plant processes (at current water usage rates) can be calculated to be 30-40 ppm. Based upon water analysis of other well and EMOS water in Santiago, the incoming water probably contains between 220-300 ppm of sulfate. The expected maximum total sulfate content in the effluent, based on current water consumption, would therefore be 340 ppm. The standard is 1,000 ppm. If these estimates are verified by testing, reducing water use by 50% would not cause the plant's effluent to exceed allowable concentrations for any of the pollutants of concern.

Table 9 presents a schedule of implementation, subject to the availability of personnel and capital, for eleven of the recommendations made in this report. Many can be implemented with no capital investment. For those projects that do require expenditures, the approximate amount of the required investment appears in the shaded window which shows the time required for implementation. Many projects can be implemented in less than two weeks. Most of those projects are not dependent upon other projects for their initiation. Instead of specifying the order in which these short projects should be done, the table places the start date for all of them in week one.

**TABLE 3**  
**Schedule of Implementation and Capital Budget**

PROJECT	WEEK														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bleach Rinse Recycle (4.1.1)															
Clean Steel Tanks															
Replumb Jet Cooling Water					\$50,000										
Replumb One Jet Bleach Rinse						\$150,000									
Test Bleach Rinse Recycle															
Refit All Jets if OK															\$300,000
Dye Rinse Recycle (4.1.2)															
Monitor Bleach Rinse Recycle															
Install Two Tanks															\$650,000
Replumb One Jet															\$50,000
Test Dye Rinse Recycle															
Refit All Jets if OK															
Replumb Boiler Blowdown (4.2.2)															\$300K
Design System															
Procurement															\$150,000

**TABLE 3**  
**Schedule of Implementation and Capital Budget**

PROJECT	WEEK															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Installation															\$50,000	
Reduce Dye Liquor Ratio (4.3.1)																
Chose Dye for Experiment	None															
Run Test					None											
Evaluate Results											None					
Standardize Chinese Reactives (4.3.2)											None					
Monitor Dye Processes (4.3.2)											None					
Compare Reactive Dye Costs (4.3.3)	None															
Replace Dispersed Red 60 (4.3.4)	None															
Install Parallel Screens (4.4.1)					\$50,000											
Maintain Parallel Screens (4.4.1)											None					
Open and Aerate Sump (4.4.2)		\$50,000														
Test Effluent Parameters (4.4.3)					\$250,000											

Implementing the recommendations in this report will lower operating costs for Tintoreria Pedro de Valdivia, S.A. by from \$3,700,000 to \$9,600,000 per year. Just as importantly, these projects will reduce the impact that the operation of the plant has on the environment. This section summarizes those environmental benefits.

### 6.1 Air Emissions

Three of the proposed changes will reduce steam consumption, lower fuel use and thereby reduce air emissions. Only the savings that can be gained through recovering the heat from boiler blowdown water have been quantified. Recapturing the heat from blowdown water should reduce fuel consumption by 2.4% or 19 metric tons of Number 5 residual oil per year. Other proposed changes which will reduce energy use, but whose savings are not included in this figure, are: 1) recovering the heat in recycled bleach water and; 2) recovering the heat in recycled dye rinse waters.

Using USEPA document AP-42, the effect of reducing consumption in a commercial steam boiler by 19 metric tons of Number 5 oil can be calculated. Table 4 presents the expected reductions. They total about 0.5 metric tons of air pollutants avoided each year. Not included in these figures are reductions in carbon dioxide emissions which reduce the plant's contribution to global warming. Heavy metal emissions will also be reduced, but cannot be quantified without fuel analysis.

**TABLE 4**  
**Reductions in Air Emissions**

POLLUTANT	AP-42 EMISSION FACTOR in KILOGRAMS per METRIC TON of #5 OIL BURNED	YEARLY REDUCTION FROM BURNING 19 FEWER TONS OF #5 OIL
Particulate Matter (All)	2.14 kg/MT	41 kg
Sulfur Oxides	20.62 kg/MT	392 kg
Nitrogen Oxides	7.15 kg/MT	136 kg
VOCs	0.036 kg/MT	1 kg
Carbon Monoxide	0.65 kg/MT	12 kg
Lead	0.00055 kg/MT	0.1 kg

**6.2 Water and Chemical Use**

If both bleach and dye rinse recycling projects are implemented, Tintoreria Pedro de Valdivia could consume 66,000 m<sup>3</sup> less water than it now does. Chemical use will decline because bleach chemicals will be recovered for reuse. The use of Fong dyeing equipment could reduce the use and release of acetic acid, formic acid and dyestuffs. Until that equipment begins to be used to better control the dye processes, it is not possible to quantify those reductions.

**APPENDIX A**

**Statement of Work**

# AMCHAM-CHILE

## ENVIRONMENT COMMITTEE

### EP3 CHILE PROGRAM.

#### TEXTILE DYEING MILL INDUSTRIES. TECHNICAL ASSISTANCE REQUISITION.

#### BACKGROUND.

The Environmental Steering Committee of AMCHAM has approved two Textile mills to participate in EP3 projects, technically assisted by the Prime Contractor.

The plan is to perform Environmental Industrial Pollution Prevention Diagnostic studies in the two Plants selected.

In order to do the job, the Prime Contractor will provide its assistance through US.experts, Pro bono consultants and local chilean consultants, contracted and paid by the Contractor.

All the Consultants should posses proven technical capabilities in PP for the Textile dyeing industrial processes, as well as expertise in dealing with gaseous emission, liquid discharge and solid waste situations in these industries.

#### US.CONSULTANT WORK TASK.

To technically assist the Plant Team in the identification of changes/ modifications to the processes, in order to reduce or abate the generation of contaminants, resulting in increased productivity and improved profitability to the operations.

#### SPECIFIC TASKS.

To assist and/ or work with the plant Team, the EP3 Coordinator and the local consultant, to achieve the listed objectives.

- .-Diagnostic Study of the Plant processes.
- .-P2 opportunities identification and analyses.
- .-Determination of the effluent base line .
- .-Technical recommendations and Reports.
- .-Implementation of P2 recommendations and options.
- .-Monitoring of changes and follow up of results.
- .-Evaluation of results.
- .-Exchange and transfer of technical information.
- .-Identification of possible capital investment solutions.
- .-Recommendations for ongoing environmental improvement.
- .-Participation in seminars and workshops on P2.
- .-Education and training to Plant personnel.

AMCHAM-CHILE  
ENVIRONMENT COMMITTEE

**QUALIFICATIONS OF THE US CONSULTANT.**

- .-Proven expertise and know-how in P2 measures and procedures.
- .-Experience in developing and supervising textile dyeing mills P2 projects. ( Assessment, implementation, monitoring, evaluation and reporting).
- .-Capability to specify and recommend technical solutions.
- .-Ability to train plant personnel.

**REQUIREMENTS FOR THE US CONSULTANT.**

- .-Provide a biodata sheet for each proposed consultant.
- .-Computer data/ info. processing (Wordperfect, Lotus).
- .-Bilingual spanish-english desired.

**CONDITIONS FOR THE US CONSULTANT.**

- .-Should be selected and contracted by the Prime Contractor.
- .-Will belong to the Plant team.
- .-Will supply his own computer, printer and software.
- .-Will coordinate activities with EP3 Coordinator.
- .-Will report to the Prime Contractor.

**DATES FOR IMPLEMENTATION.**

1st.VISIT: NOVEMBER 15 through DECEMBER 03.

( or earlier if Technical Assistance Agreements signed out by Plant Board/ Managers in advance).

BEST AVAILABLE DOCUMENT

**AMCHAM-CHILE**  
**ENVIRONMENT COMMITTEE**

**EP3 WORK PLAN FOR TEXTILE DYEING MILLS.**

**BACKGROUND.**

The AMCHAM Steering Committee has approved one Textile dyeing mill as candidate to initiate individual Plant projects in this industrial sector.

These Projects should start right after signature of a Private Agreement with each candidate plant.

**INDUSTRIES SELECTED.**

**QUIMICA Y TEXTILES PROQUINDUS SACI. (Mid size plant).**

**POLLUTION SITUATION.**

This plant works in batch processes, producing mostly wool and cotton fabrics; they also treat polyester and synthetic mixes in small volumes as per customer orders.

Main concern here is the water pollution from extensive usage of a variety of chemicals to treat, dye and finish the fabrics; waste water flows directly into the sewage system.

The gaseous emissions come from their boilers and some treatment processes, whereas the solid waste is restricted to trimmings, pile and minor amounts of residues left behind in the vessels and tanks, after washing or cleaning.

**WORK PLANS.**

The Prime Contractor should conduct a Diagnostic Study in each of these Plants in order to identify Pollution Prevention opportunities, aimed at reduction/ abatement of pollution through low cost changes and modifications to their processes.

In order to perform the Study, the Contractor must develop a specific Execution Work Plan for every Industry Sector (and/ or plant) already approved by AMCHAM Steering Committee. The Execution Work Plans should be submitted to the Steering Committee for approval, right after the first plant visit as per the Work sequence to follow.

**AMCHAM-CHILE**  
**ENVIRONMENT COMMITTEE**

**TASKS AND ACTIVITIES-WORK SEQUENCE.**

The Contractor Execution Plans for each Plant will include tasks and activities following the sequence below.

- .-Orientation meeting with EP3 Coordinator upon arrival of Prime Contractor team to Chile ( 1st.visit of Experts).
- .-Meeting with Plant Board and/or Managers.
- .-Diagnosis Study of plant and processes.(Plant tour assessment).
- .-Develop Execution Work Plan (Copy to Steering Committee and Plant Board).
- .-Effluent base line: recommendations and determination.
- .-Plant data/ information collection:cost, processes,functions.
- .-Pollution prevention opportunities analyses /identification.
- .-Draft report on recommendations with strategies and actions, incorporating the Execution Work Plan.
- .-Review of draft Report with Plant Managers.
- .-Team formation and task definitions.
- .-List of criteria to analyze/ select P2 options.
- .-Exit meeting with Steering Committee.
- .-Final report on Recommendations to Plant Board with confirmatory analyses and supplemental information for best preferred option to implement in plant.
- .-Implementation of best option in plant ( 2nd.visit of Experts)
- .-Monitoring/ follow-up.
- .-Information transfer and control.
- .-Periodical reports on progress.
- .-Evaluation of results ( 3rd.visit of Experts).
- .-Final report of results.
- .-PLAN II assessment after evaluation (Capital intensive solutions).
- .-Report recommendations for PLAN II capital intensive solutions.

During the visits of P.C.team, time should be spent in seminars, workshops and training sessions to members of the Plants involved.

Similarly, the participation of experts in open seminars dealing with general P2 topics, waste minimization techniques and procedures, clean technologies and related subjects directed towards Academia, Industry Associations and University students may be considered if time permits.

**PRIME CONTRACTOR RESPONSIBILITIES.**

The Contractor will have to select and contract US.experts and Probono consultants, as well as hiring local chilean consultants in order to provide in-plant assistance to the projects.

AMCHAM-CHILE  
ENVIRONMENT COMMITTEE

**TIMEFRAME.**

First visit of US Team experts should be programmed and take place immediately after Contractor receives written fax notice from EP3 Coordinator, of the signature of Technical Assistance Agreement by the Plant Board/ Managers.

It is expected that the entire process of Diagnostic Study to the stage of Exit meeting with the Steering Committee, will not extend beyond 5-6 working days for every one of the Projects, during the first visit of the team of experts.

On return to the US. the experts will review their preliminary analyses and recommend the most attractive P2 options to address waste reduction opportunities; a Final Report sent to the EP3 coordinator for review of the Plant Board, will allow the Plant to choose the option which would best fit its capabilities and undertake its action plans.

The implementation of the best option selected by the Plant will take place immediately after Plant Board approval, during the second visit of the Team of experts. This step may not take more than 2-3 working days.

Time for monitoring/ follow-up will vary for every particular project and plan.

A third final visit of experts has been programmed for the Evaluation of results, Final Project Report and PLAN II Capital intensive recommendations. It is expected to complete this stage in 5 working days.

It is important to stress that, to the extent possible, experts in such disciplines as Water treatment and Boiler/ burner operations should be used in several plant visits during their trip to Chile.

BEST AVAILABLE DOCUMENT

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November 10, 1993

### EP3, CHILE Textile dyeing Industries Technical Assistance

#### DESCRIPTION:

**EP3 Chile** has identified interested industrial plants in the textile dyeing sector. A letter of intent has been received, from three industrial plants in this sector. The plan is to perform Pollution Prevention (PP) environmental audits (for Chile they'll be called Diagnostic Analyses because of a negative connotation of the word "audit" there) in those three industrial plants.

EP3-HBI will let sub-contracts with USA and/or local consultants with proven technical capabilities in PP for the textile dyeing industrial process. For each industrial sector (ie. three industrial plants), one individual from a US Sub-contractor or Chilean Sub-contractor will be assigned as Team leader, and he/she will be responsible for the diagnostic analyses/audits and follow-up of each industry. It is expected that diagnostic analyses/audits will not extend beyond 2-3 calendar days. The objective will be to identify as many as possible low-no cost changes to process/controls/materials which will result in pollution reduction and improved efficiency. The diagnostic analyses/audits will also identify possible capital intensive PP modifications and/or equipment, instrumentation modification and/or installation. The Team leader will have operational responsibility, including supervision/coordination of the other Team members (local consultants, US pro-bono experts and/or other US consultants). It is expected that the Teams will be made up of three individuals, a Team leader, an Industrial Pollution Prevention, IPP, expert and a Chilean consultant counterpart. The Team Leader will coordinate closely and report to EP3/Chile through its coordinator, Mauricio Roldán. The PPI will also assure that the Chilean consulting/engineering team members will be active participants in all technical activities with the objective of maximizing PP transfer of expertise. EP3-HBI through the EP3 coordinator, will have overall responsibility for supervision of all sub-contractors.

The Team will use the UNIDO, UNEP, AUDIT AND REDUCTION MANUAL for INDUSTRIAL EMISSIONS AND WASTES, supplemented by the EPA WASTE MINIMIZATION ASSESSMENT WORKSHEETS for the diagnostic analyses/audits.

POSITION TITLE: Industrial pollution prevention (IPP) expert

QUALIFICATIONS: Proven experience in performing similar PP activities, experience/expertise in identification of PP measures, in development of the necessary instructions/specifications required for the implementation of the recommended modifications, in training of operators, monitoring/evaluation of results in textile dyeing industrial plants. **Candidate** must provide a brief (2 page max.) outline of proposed plan for the Pollution Prevention Diagnostic Analysis for a textile dyeing plant.

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DATES: November 15 through December 5, 1993

#### **REQUIREMENTS:**

Provide a BIODATA sheet for each proposed candidate.

Once the IPP expert is selected, he/she will actively participate, jointly with EP3-HBI, in the selection process for the other Team members as well as in the coordination of Environmental Field sampling to be done by Chilean contractors.

Electronic word processing, spreadsheet proficiency and Windows familiarity, as well as Spanish Language capabilities and International consulting experience

Names and contact tel. #s of individuals who can provide references related to consultants' PP experience/expertise in textile dyeing industrial plants in USA or elsewhere

There will be a "pre-trip" briefing in EP3-HBI project office in Arlington, VA. (1-2 days). Upon arrival to Chile, EP3 Team will review their workplan/schedule with the appropriate USAID mission personnel.

IPP expert will assist Team leader to prepare a brief (one page MAXIMUM) weekly status report for the appropriate USAID mission person/office.

EP3 IPP expert will assist the Team leader in the EP3 Team's preparation of a Trip Report. This Trip Report will be presented by the Team to the appropriate USAID mission person/office BEFORE leaving the host country. If necessary, this Trip Report can be presented in "draft" form, for finalization, formatting, etc. upon return to the EP3-HBI project office.

Whenever possible, the EP3 Team will use the Windows based, PRIDE-EP3 USAID Audit Assessment System. WordPerfect 5.1 and LOTUS 123 will be used for all reports. The consultants will supply their own computers and software. A diskette with all electronic, WP5.1 and LOTUS, files will be submitted to the EP3-HBI Project office with the hard copies of the reports.

There will be a one day, "post-trip" briefing, by the IPP expert, at the EP3-HBI project office in Arlington, VA, (within 1 week after departure from the host country). At this time, the final Trip Report must be completed and delivered to the EP3-HBI project office, together with the computer files.

RCG, Hagler Bailly

EP3 Program. Page 2

**APPENDIX B**

**Industry Agreement**

**CONTRATO DE MUTUA COOPERACION  
ENTRE  
El Programa EP3 Y (EMPRESA)**

Se celebra el presente Contrato con fecha 6 de Abril de 1993, por y entre El Programa de Prevención de Contaminación (en lo sucesivo denominado "El Programa EP3") financiado por la Agencia de los Estados Unidos para el Desarrollo Internacional, (en lo sucesivo denominado como "USAID") en Chile, y que cuenta con el respaldo de la Cámara Chilena Norteamericana de Comercio A.G. (en lo sucesivo denominado como "AMCHAM"), y que recibirá asistencia técnica de RCG/Hagler, Bailly, Inc. como Contratista Principal (en lo sucesivo denominado como "EP3-HBI"), con sus oficinas situadas en la Cámara Chilena Norteamericana de Comercio A.G., Avenida Américo Vespucio Sur 80, piso 9, Casilla 82, Santiago 34, Chile, por una parte; y por la otra parte la Tintoreria Pedro de Valdivia, (en lo sucesivo denominado "EMPRESA"); domiciliada en Avda. Pedro de Valdivia 5852, Santiago, Chile;

Y

POR CUANTO "EP3-HBI" ha sido contratado por la Agencia de los Estados Unidos para el Desarrollo Internacional para que le proporcione al Programa EP3 servicios de administración y apoyo técnico;

Y

POR CUANTO la EMPRESA manifestó su deseo de participar en El Programa EP3, de ejecutar un Estudio de Diagnóstico de Prevención de Contaminación y de implementar sus recomendaciones;

LAS PARTES VIENEN, EN VIRTUD DE LO EXPUESTO, A CONVENIR LO SIGUIENTE:

**1. RESPONSABILIDADES DEL PROGRAMA EP3**

- 1.1 El Programa EP3 y EP3-HBI ejecutarán directamente y/o contratarán (sin costo para la EMPRESA) un análisis diagnostico de prevención de contaminación que será hecho por técnicos/expertos Chilenos asistidos por técnicos/expertos extranjeros, cuando sea necesario. Entre la primeras actividades del estudio diagnostico será establecer una base de referencia de las composiciones actuales de los efluentes de la EMPRESA.
- 1.2 El Programa EP3 y EP3-HBI le enviarán a la EMPRESA, para su respectiva aprobación y consentimiento, un Alcance de trabajo recomendado para la EMPRESA.
- 1.3 El Programa EP3 designa aquí al señor Mauricio Roldán como Coordinador del Proyecto, quien asume una responsabilidad

**contractual y operativa directa en virtud del presente Contrato.**

**El señor Roldán será también responsable de verificar el cumplimiento de las condiciones del presente Contrato.**

**2. RESPONSABILIDADES DE LA EMPRESA**

- 2.1** La EMPRESA cooperará con los técnicos del Programa EP3, suministrará las informaciones técnicas, administrativas y contables, relacionadas a los procesos de fabricación necesarias para analizar los sistemas de producción. El objetivo de esto es identificar posibles cambios en ellos, en las materias primas (si es posible), en los productos químicos, en los controles de producción, y en otros variables para reducir la emisión de contaminantes, y que incidirá en el mejoramiento de la productividad y la rentabilidad operacional.
- 2.2** La EMPRESA también proveerá a los técnicos del Programa EP3 las informaciones, mediciones o datos relacionados a las actuales composiciones de los efluentes de nuestra EMPRESA y sobre proyectos de mejoramiento ambiental en ejecución o en planificación. En caso que no tengamos datos cuantitativos sobre la composición actual de efluentes, permitiremos que El Programa EP3 directamente o usando sub-contratistas de USA o Chilenos tome mediciones cuantitativas sobre la composición de los efluentes como parte del estudio diagnostico de prevención de contaminación.
- 2.3** La EMPRESA requiere que todos los datos confidenciales de procesos de propiedad de la EMPRESA, o datos relacionados a composición de efluentes que suministre, o cualquier información operacional o comercial que obtengan los técnicos del Programa EP3 en la EMPRESA, serán tratados con **máxima confidencialidad**, y que no serán divulgados a ninguna entidad Pública o Privada sin previa aprobación por escrito por parte de la EMPRESA.
- 2.4** La EMPRESA tendrá la última decisión y aprobación de cualquiera recomendación que haga el programa EP3, y por ende, la EMPRESA releva al Programa EP3 de toda responsabilidad legal relacionada a la implementación de las recomendaciones del Programa EP3 o de sus resultados.
- 2.5** La EMPRESA está de acuerdo con que el Programa EP3 inicialmente, tratará de identificar modificaciones que no impliquen mayores inversiones o costos.
- 2.6** La EMPRESA implementará las modificaciones identificadas y recomendadas por El Programa EP3, siempre y cuando estas, según evaluación de la EMPRESA, no sean perjudiciales a los productos, a los sistemas de producción, ni a las prácticas

comerciales y de ventas.

- 2.7 La EMPRESA permitirá que El Programa EP3 le de publicidad a los resultados de las innovaciones recomendadas por el Programa EP3, y permitirá que otras industrias con procesos similares se beneficien de las experiencias de nuestra EMPRESA, siempre y cuando esto no involucre procesos de propiedad de la EMPRESA, y que se puedan transferir a otras industrias del sector. Los resultados no serán divulgados a ninguna entidad Pública o Privada sin previa aprobación por escrito por parte de la EMPRESA. Esta divulgación de resultados se podrá hacer durante los dos (2) primeros años siguientes a la puesta en marcha e iniciación operativa de las modificaciones o aplicaciones, de forma que otras empresas puedan observar las tecnologías en operación. Estas visitas serán aprobadas por el Gerente de Proyecto de la EMPRESA, y se programarán de forma tal de minimizar perturbaciones en las operaciones de la EMPRESA.
- 2.8 La EMPRESA obtendrá también las licencias, permisos y otros documentos oficiales que puedan requerirse. La EMPRESA se encargará del pago de cargos locales. La EMPRESA será responsable del almacenamiento y de la seguridad de todos los instrumentos y/o equipos de los técnicos del Programa EP3 desde su llegada a ésta.
- 2.9 La EMPRESA se compromete a pagar los costos de implementación de la recomendaciones del Programa EP3 que sean aceptadas por la EMPRESA.
- 2.10 La EMPRESA accede a proporcionar personal operativo y de mantenimiento que esté capacitado para recibir entrenamiento para la Operación y Mantenimiento de los equipos, instrumentos o recomendaciones operacionales según lo soliciten El Programa EP3 y EP3-HBI o el consultor/contratista local que contrate El Programa EP3 para el Programa EP3. La EMPRESA tambien se compromete a promocionar una ética de Prevención de Contaminación que adoptará e implementará la siguiente politica ambiental formalizada, que incluirá a todo su personal:

"Para la EMPRESA, la protección del medio ambiente tendrá máxima prioridad. Nuestro compromiso será eliminar o reducir la utilización de sustancias tóxicas y reducir al mínimo el uso de la energía y la generación de todo tipo de desechos, siempre que sea posible. Preferimos prevenir la contaminación en la fuente que controlarla y/o tratarla al final del proceso industrial. En los casos que no se puede evitar que haya desechos, trataremos de reciclar, de tratar o eliminar desechos por medios que reduzcan al mínimo los efectos nocivos para la atmósfera, las aguas y la tierra."

- 2.11 La EMPRESA proporcionará personal con capacidades técnicas suficientes para ejecutar las funciones de verificación o implementación que identifique El Programa EP3. Se le proporcionará toda la información disponible a Programa EP3 que sea necesaria para formular sus recomendaciones.
- 2.12 Luego de la ejecución del presente Contrato, el personal técnico de la EMPRESA y del Programa EP3 realizarán conjuntamente el seguimiento de los resultados. Se registrarán toda medida y parámetros necesarios, como ser las emisiones y los efluentes, para verificar la reducción de los efluentes y de las emisiones.
- 2.13 La EMPRESA designa a Edgar Morris como su Gerente de Proyecto, quien asumirá las responsabilidades de revisión técnica de la EMPRESA en relación a la implementación del Programa EP3. El Gerente de Proyecto actuará también como enlace entre la EMPRESA y El Programa EP3/EP3-HBI y/o con los consultores/contratistas extranjeros o Chileno, que contrate El Programa EP3 para este Proyecto.
- 2.14 La EMPRESA le proporcionará espacio de trabajo a los representantes del Programa EP3 cuando éstos se hallen en la EMPRESA durante las fases de medición, implementación de las recomendaciones, y puesta en marcha de operaciones, y también durante el seguimiento de las implementaciones de las recomendaciones y las evaluaciones y/o mediciones de los resultados.
- 2.15 La EMPRESA conviene en participar, con otras firmas y con El Programa EP3, en la promoción de la "aplicación de tecnologías de prevención de contaminación", asistiendo a seminarios y talleres.
- 2.16 La EMPRESA declara que ni El Programa EP3 ni USAID ni EP3-HBI ni sus respectivos contratistas y sub-contratistas, serán responsables por ningún daño directo o indirecto, especial o consecuencial; incluyendo, sin que esta enumeración sea limitante, pérdida de energía, costo de reponer energía, imposibilidad de uso o pérdida de ganancias que pudiesen resultar de la implementación de recomendaciones emanadas de los Estudios Diagnósticos de Prevención de Contaminación o de cualesquier otros servicios prestados por El Programa EP3, por USAID o por EP3-HBI o por sus respectivos contratistas y sub-contratistas en virtud de este Contrato.
- 2.17 La EMPRESA declara que ni El Programa EP3 ni USAID ni EP3-HBI ni sus respectivos contratistas y sub-contratistas, serán responsables por daños personales, pérdidas o daños a la propiedad que pudiesen resultar de la Aplicaciones Técnicas descritas en este documento. La EMPRESA se compromete a indemnizar, a defender y a mantener libre de perjuicio al Programa EP3, a USAID y a EP3-HBI y a sus respectivos contratistas y sub-contratistas por y ante

cualesquier demandas, juicios o procedimientos provocadas por o relacionadas con cualquier acto o emisión en relación con la ejecución de los servicios objeto del presente Contrato..

- 2.18 Queda convenido que la EMPRESA procurará sus propios seguros como única medida paliativa ante daños personales, pérdidas o daños a la propiedad o ante cualquier otra pérdida o daño resultantes de o relacionados con la prestación de los servicios ejecutados por El Programa EP3, por USAID y por EP3-HBI y por sus respectivos contratistas y sub-contratistas en el cumplimiento del presente Contrato. La EMPRESA acepta liberar, por el presente instrumento, al Programa EP3, a USAID y a EP3-HBI y a sus respectivos contratistas y sub-contratistas, de responsabilidad por cualesquier pérdidas o daños que pudiese sufrir la EMPRESA por razones de cualquier clase que sean, en este respecto.
- 2.19 Se espera que la EMPRESA proporcione indemnización o cobertura a su propio sub-contratista, si lo hubiese, sobre cualquier equipo o instalación de instrumentos en el transcurso de sus prácticas normales de contratación, y que tales medidas puedan incluir cualesquier fuerzas mayores, retrasos, daños liquidados o garantías de cumplimiento que la EMPRESA pueda desear, pero se entiende también que tales medidas no involucrarán en forma alguna los resultados de cualesquier actos u omisiones del Programa EP3 ni de EP3-HBI ni de ninguno de sus contratistas y sub-contratistas.

### 3. OBLIGACIONES FINANCIERAS DE AMBAS PARTES

- 3.1 El Programa EP3/EP3-HBI o el consultor/contratistas extranjeros o Chilenos contratados por El Programa EP3 para este Proyecto, no tienen obligación financiera alguna para con la EMPRESA. En igual forma, la EMPRESA no tiene obligación financiera alguna para con el Programa EP3/EP3-HBI o el consultor/contratistas extranjeros o Chilenos contratados por El Programa EP3 para este Proyecto.

### 4. DURACION DE ESTE CONTRATO

- 4.1 Este contrato tendrá una duracion suficiente para efectuar los estudios diagnósticos descritos anteriormente, y para implementar las recomendaciones del Programa EP3, pero en ningún caso será mayor de un (1) año a partir de la fecha de la firma de este contrato. El período de duracion solamente podrá ser modificado por medio de un acuerdo formal por escrito, entre las dos partes.

## 5. DISPOSICIONES GENERALES

### 5.1 Honorarios Eventuales

- A) La EMPRESA garantiza que no ha empleado ni le ha pagado a ninguna persona ni agente de ventas para que solicite u obtenga este Contrato en base a un contrato de entendimiento por comisión, porcentaje, corretaje u honorarios anticipados; a excepción de empleados de buena fe o de agencias comerciales o de venta establecidas que la EMPRESA mantenga para efectos de procurar negocios.
- B) En caso de infringimiento o violación del presente Contrato, El Programa EP3 tendrá el derecho de detener todas las actividades sin contraer responsabilidad por ello.

### 5.2 Efecto Legal de la Aprobación y Decisión de USAID

Las Partes suscritas manifiestan entender que el presente Contrato reserva ciertos derechos para USAID, tales como (pero no limitándose a): el derecho de aprobar las condiciones del presente Contrato, y también la EMPRESA y cualesquier otras industrias, los informes, las especificaciones, los sub-contratos, los documentos de licitación, los planos u otros documentos relacionados con el presente Contrato, como también el Proyecto del que este Contrato forma parte. Las partes suscritas declaran también entender y aceptar que USAID, al reservarse cualesquiera o todos los derechos de aprobación mencionados, actúa únicamente como una entidad financiera para asegurar el uso adecuado de los fondos del gobierno de los Estados Unidos, y que cualquier decisión que USAID tome de ejercer o de abstenerse de ejercer tales derechos de aprobación, será en cuanto parte financiante en el curso del financiamiento de este Proyecto, no significando que USAID entre a ser una parte del presente Contrato.

Las Partes suscritas declaran entender y aceptar que USAID puede, de vez en cuando, ejercer los derechos de aprobación mencionados, o bien discutir materias relacionadas con tales derechos y con el Proyecto, ya sea con las partes en conjunto o separadamente, sin que por ello incurra en responsabilidad alguna ante las partes, ni en conjunto ni en forma separada. Cualquier aprobación (u omisión de aprobar) por parte de USAID no privará al Programa EP3 ni a EP3-HBI ni a USAID de ejercer sus derechos, ni liberará a la EMPRESA de ninguna responsabilidad que ésta pudiese tener, de no haber mediado tal ejercicio, ante El Programa EP3, ante EP3-HBI o ante USAID.

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### **5.3 Inspección**

La EMPRESA consiente en permitir acceso a los representantes autorizados del Programa EP3 y de USAID, en cualquier momento razonable, para que inspeccionen las instalaciones, las actividades y el trabajo relacionado con este Contrato, y también para que adopten medidas de trabajo y realicen pruebas durante la vigencia del presente Contrato.

### **5.4 Notificaciones**

Cualquier notificación que entregue al Programa EP3/EP3-HBI tendrá validez y efectividad solamente si se emite por escrito y se entrega al coordinador del Programa EP3 o a la EMPRESA en las direcciones consignadas en este Contrato. Las notificaciones entrarán en vigencia al momento de su entrega o a la fecha consignada como efectiva, lo que ocurra primero.

### **5.5 Ley que Requirá**

El presente Contrato se interpretará de acuerdo con las leyes de la República de Chile, y en caso de litigio, este se tramitará en la ciudad de Santiago.

## **6. COPIAS DE ESTE CONTRATO**

6.1 Este documento se hará en cuatro originales, uno para el Programa EP3, uno para la EMPRESA, uno para AMCHAM y uno para EP3-HBI.

Se declara que las partes, por medio de sus representantes debidamente autorizados, están de acuerdo con las cláusulas de este contrato.

Por la EMPRESA

Nombre: Patricio Majluf

Cargo: Gerente General

Firma:

Fecha: 03 Diciembre 1993

Por el Programa EP3

Nombre: Eduardo S. Maal

Cargo: DEPUTY DIRECTOR

Firma:

Fecha: 03 Diciembre 1993